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Abstract

CALCULATIONS ON POWER FAST REACTORS PHYSICS

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The main feature of fast reactors is the possibility to develop on their own fuel. The rate of this development is defined both by the characteristics of the reactor itself and by the parameters of fuel cycle: burnup, reprocessing time, fuel losses during reprocessing. Equations describing reactor breeding both for one kind of fuel and for the case of different fuels mixture are formulated. The dependence of fuel doubling time on the characteristics of fast reactor developing system is obtained.

Reactor characteristics are defined primarily by the kind of fuel and by possible heat transfer conditions in the core and blankets. Two different possibilities are considered from this point of view. The first one is connected with the use of oxide fuel and with such heat transfer conditions that are based on design studies and experiments. The second possibility is connected with the future increase of coolant parameters, of its heating and with the use of thin-canned carbide fuel element.

Heat engineering restrictions in powerful reactors do not permit to place sufficient amounts of fuel and fertile material in the core. In this connection the means to decrease the volume fraction of coolant and to increase fuel and fertile material content are considered. One way to achieve this is to flatten the core, and another one is to vary phy-

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sical properties over the core. The significance of power distribution flattening and different means of its realizotion are considered.

Power distribution flattening is shown to allow the improving of reactor physical characteristics.

Both different physical reactor characteristics as a function of composition and the significance of different materials for neutron balance are analyzed.

Reactor breeding rate as a function of reactor characteristics and reprocessing parameters is shown on the basis of doubling time comparison.

Optimum power density (from the doubling time point of view) and its dependence on the reactor power at different original assumptions is considered.

The results of thorium cycle studies for fast reactors are given, joint cycle is proposed where plutonium and uranium-233 are used as fuel and uranium-238 - as fertile material in the core. Thorium serves as fertile material in the blanket. As a result uranium-233 is generated in blankets and plutonium - in the cores.

The principle characteristics of separate and joint systems are analyzed, doubling time comparison is performed and the rate of joint system breeding is shown to be not much less than plutonium system breeding rate.